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A METHOD FOR TESTING AEROSOLS AGAINST COCKROACHES

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At the Beltsville, Md., laboratories cockroaches have been used as test insects in the development of the liquefied-gas method of propelling insecticides as aerosols. In the early work no special techniques were used, the roaches being freed in large rooms in practical-type tests or sometimes confined in screened cages. In 1945 a technique was developed by which German cockroaches confined in small crystallizing dishes were exposed on the floor of a Peet-Grady chamber. In July 1946 an improved method was developed which has been used successfully since that time, and which is described herein. The results obtained with a standard aerosol against four species of cockroaches are also shown.

The insects are exposed to the aerosol while confined in an open pen on the floor of a Peet-Grady chamber. After 30 minutes they are transferred to clean holding cages and provided with food and water. Mortality counts are taken on the first, third, and fifth days after the exposure.

Equipment and Method

A standard Peet-Grady chamber 6 by 6 by 6 feet is used. The walls, ceiling, and floor are permanently covered with heavy paper to prevent contamination with residues due to excessive dosages. The pen is a wooden frame 30 inches square (i.d.) lined with glass (fig. 1). It is made of pieces of wood 3 inches wide and 1 1/4 inches thick, and lined with double-weight pieces of glass 4 inches wide and 30 1/8 inches long. One end of each piece of glass overlaps that of the adjacent piece and fits into a 1/2-inch groove in the corner of the wooden frame (fig. 2). The frame is strengthened on the outside by two 8-inch angle irons at opposite corners.

Before a test is made, a piece of gray bogus paper approximately 40 inches square is put in the center of the floor of the chamber. The pen is placed on this paper with the corners pointing toward the center of the chamber walls. The pieces of glass are thinly coated with mineral oil to confine the insects.

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For each test 20 roaches of a given species and sex are placed in the pen. The chamber is closed, and the required amount of aerosol is dispensed into it with a constantly waving motion from an aerosol container or from the pressure test-tube type of laboratory dispenser, which delivers calibrated dosages. At the end of the exposure the chamber is ventilated and the insects are transferred to recovery cages. The glass lining of the pen and the square of paper beneath it are replaced and the chamber is ready for another test.

Determination of Exposure Time

The best time of exposure was determined in tests with large nymphs and adult females of the American cockroach, using a pyrethrum-sesame oil aerosol. The insects were exposed for 15, 30, or 45 minutes, some being introduced at the time the aerosol was released and others after 15 or 30 minutes.

Table 1 shows that a 30-minute exposure was satisfactory and that any aerosol remaining in the air after that time was ineffective. A 15-minute exposure was too short.

Table 1.--Effect of exposure time on the toxicity of a pyrethrum-sesame oil aerosol to the American cockroach

Exposure (minutes)	Percent mortality in--			
	1 day	3 days	5 days	7 days
		Adult females		
First 15	0	5	23	23
First 30	0	42	61	61
First 45	11	47	69	69
15th to 45th	0	5	17	20
30th to 45th	0	0	0	0
		Large nymphs		
First 15	0	6	18	18
First 30	0	35	57	57
First 45	0	39	48	51

Mortality Counts

The importance of the time between exposure and the taking of mortality counts has been commented on by various workers.

In the early work mortality counts were taken daily for 10 days. Later the final counts with American cockroaches were made after 7 days and then after only 5 days. With German cockroaches 4-day counts were found to be satisfactory.

Table 1 shows the same mortalities of American roaches at the 5- and 7-day counts and marked differences between the 3- and 5-day counts. In 122 previous tests on American cockroaches with 19 aerosol formulas, the 5- and 7-day counts of large nymphs and adult females combined showed average kills of 79 and 84 percent, respectively. For the method described here counts are made after 1, 3, and 5 days regardless of the species being tested.

Knock-down counts are unreliable in roach testing.

Resistance of Cockroaches to a Standard Aerosol

The resistance of four species of cockroaches--the American cockroach (Periplaneta americana (L.)), the German cockroach (Blattella germanica (L.)), the oriental cockroach (Blatta orientalis L.), and the brown-banded cockroach (Supella supellectilium (Serv.))--to a standard aerosol was determined. The Tentative Official Test Aerosol of the Chemical Specialties Manufacturers' Association was used. This aerosol contains 2 percent of pyrethrum extract (pyrethrins 20 percent), 2 percent of DDT, 11 percent of petroleum distillates, and 85 percent of Freon 11 and 12 (1:1). The aerosol was released at dosages of 5, 10, and 20 grams per chamber.

Figure 3 shows that the oriental and German cockroaches were about equally resistant, and that both were considerably more resistant than the American and the brown-banded cockroaches, the latter being the least resistant. It also confirms previous findings that the adult female is more resistant than the male, and that the nymphal stage is the most resistant. Nymphs of the German cockroach were not tried in these tests, but McGovran and Fales (1) found that these nymphs were not so resistant as the adult females. The nymphs of the American cockroach show little difference in resistance between sexes, which is not true in the adult stage.

The data obtained should be especially useful to persons using roaches to test low-pressure aerosols by the method described. The dosages required to kill any stage of the four species used in these studies may be readily determined. For nymphs of the oriental cockroach a dosage well in excess of 20 grams would be necessary to obtain medium kills. Adult males of the American and brown-banded cockroaches showed extreme lack of resistance to 1.25 and 2.50 grams per chamber. After

5 days 95 percent of the American and 70 percent of the brown-banded cockroaches were killed by the lower dosage and all the roaches of both species were killed by the higher dosage.

Dosage Adjustment for Use in Chambers of Different Sizes

Dosages for testing roaches by this method in spaces smaller or larger than a Peet-Grady chamber are easily determined. The dosage to use on a given insect and stage, based on the results given in figure 3, is in direct proportion to the ratio between the area of the floor of the room and that of a Peet-Grady chamber.

Literature Cited

(1) McGovran, E. R., and Fales, J. H.
1942. Roach testing. Soap and Sanit. Chem. 18(3): 101, 103, 105, 107, 117.

Figure 1. --Roach-testing pen.

Figure 2. --Detail of corner construction of roach-testing pen.

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Figure 3.--Relative resistance of four species of cockroaches to low-pressure Freon aerosol at three dosages in Peet-Grady chamber.